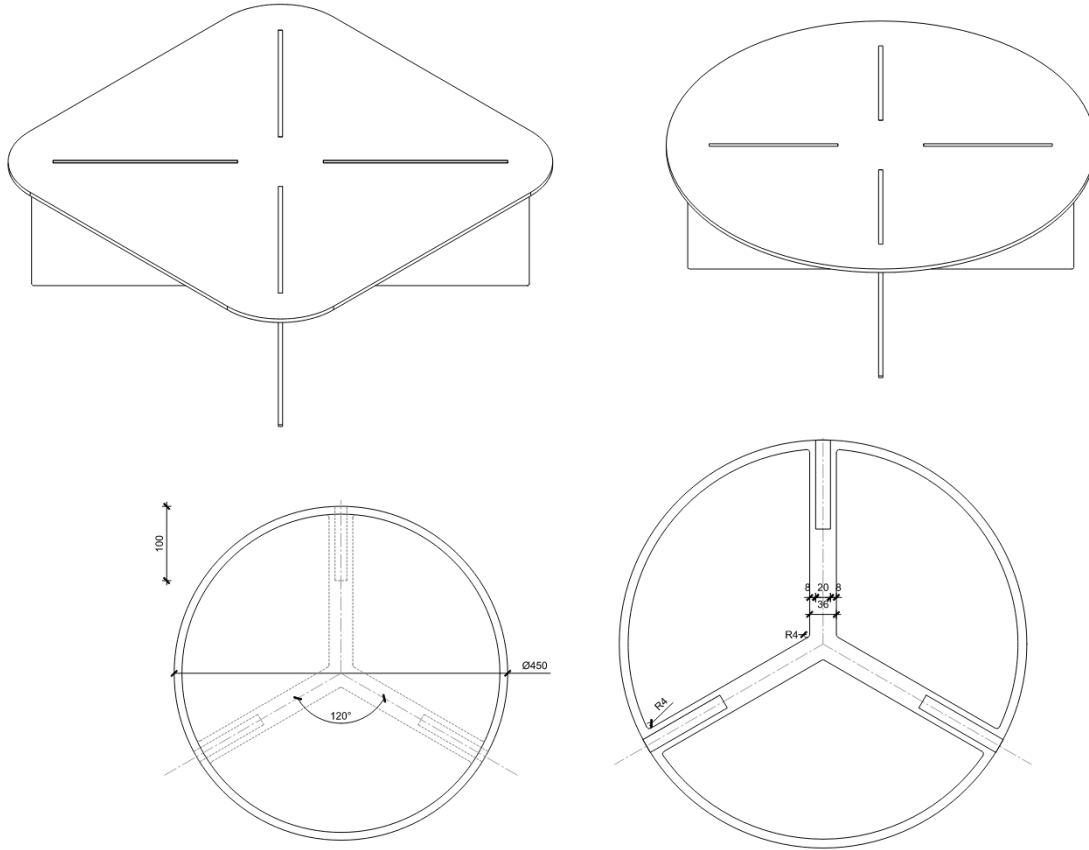




professor max irvine **engineers**



## ***Elan Plus Tables and Benches Structural Analysis Report***

**15 March 2021**

Revision A

Prepared by	Reviewed by	Status	Revision	Date
WW	MG	For review	A	15/3/21

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## Introduction

The purpose of this report is to summarise the strength and stability of the current design of the Elan Plus Coffee Tables and Tray Tables. The following design drawings were used for the calculations:

- Coffee Tables Rev A
- Tray Table 400 Rev A
- Tray Table 500 Rev A

## Assumptions

### Material assumptions

Material	Density (kg/m <sup>3</sup> )	Modulus of Elasticity (GPa)	Yield Stress (MPa)	Ultimate Tensile Strength (MPa)	Thermal Expansion Coefficient
Aluminium 6060 T5	2700	68.9	145	186	20.9 x 10 <sup>-6</sup> / °C

	Assumed F grade	Density (kg/m <sup>3</sup> )	Modulus of Elasticity (GPa)	Joint group	f <sub>b</sub> (MPa)	f <sub>t</sub> (MPa)	f <sub>c</sub> (MPa)	f <sub>s</sub> (MPa)
American Oak	F14 seasoned	750	12.3	JD3	36	22	27	3.3

### Load Assumptions

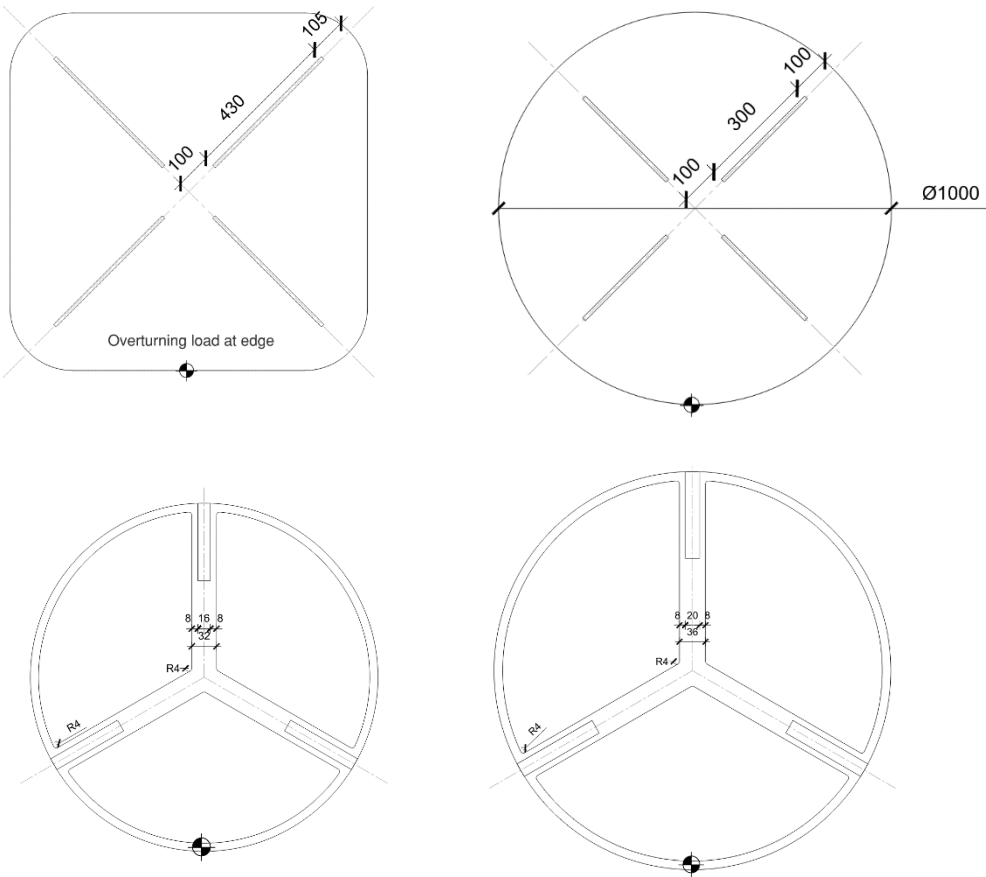
The following load cases were considered for each element, with standard cases as recommended in AS-NZS 4442-2018, AS 4688.1-2018 and AS 4688.1-2000 as well as extreme ultimate load cases. Since there are no test levels for tables, we will assume similar vertical loading test levels for seating as a conservative analysis approach.

Element	Loading
Coffee Tables	1) 200kg static central point load (Test Level 6)
Tray Tables	1) 200kg static central point load (Test Level 6)

# Analysis Results

## Overturning stability

Overturning is a governing load case for the coffee and tray tables



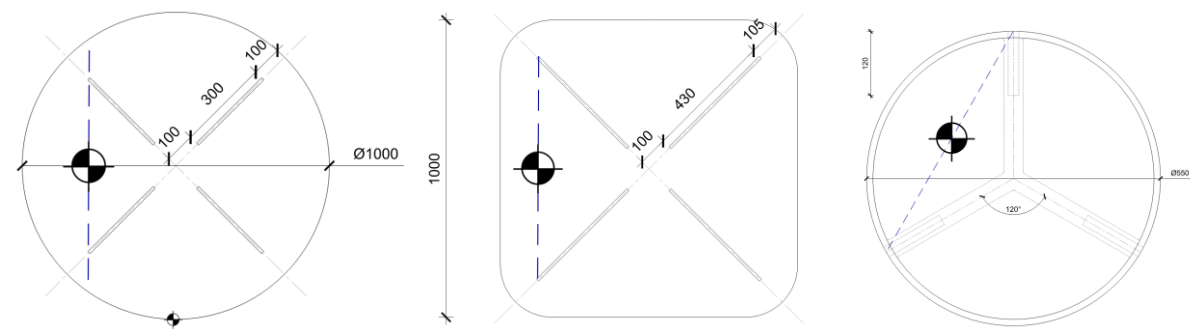
Item	Overturning load (kg)
Square Coffee Table	229
Circular Coffee Table	70
Tray Table 400	4
Tray Table 500	6

## Table Leg capacity

Item	Max lateral load capacity on single leg (kg)	Max vertical load capacity on single leg
Square Coffee Table	>200kg	>200kg
Circular Coffee Table	>200kg	>200kg
Tray Table 400	26	>200kg
Tray Table 500	38	>200kg

Despite the square and circular coffee table legs exhibiting a high lateral load capacity, it is likely this load will not be able to be fully realised due to the top of the legs not being mechanically fixed to the tabletop.

## Table Top Capacity

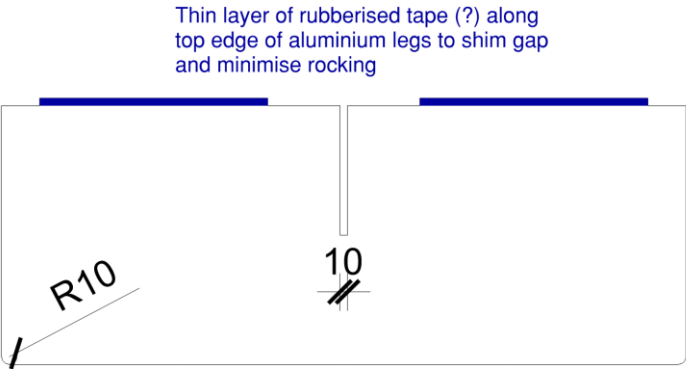


Item	Max central point load between legs (refer diagrams above) (kg)	Deflection with 200kg point load at midspan between legs (mm)
Square Coffee Table	>200kg	11
Circular Coffee Table	>200kg	6
Tray Table 400	>200kg	5
Tray Table 500	>200kg	9

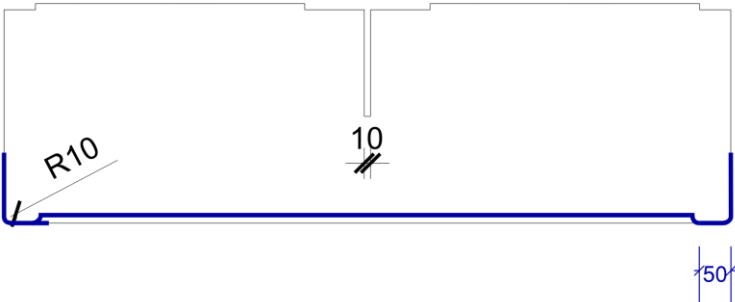
Despite the load capacities being quite high for all the tables, it is more likely overturning will govern the performance of these tables.

## Connections

There is currently no mechanical fixing specified for the circular and square coffee tables. It is expected there will be some movement within the slots of the aluminium and rocking if the table is pushed laterally. It would be recommended to use a small layer of rubberised tape along the top edge of each leg to help shim the gap and minimise the rocking.



A foot or glide at each corner of the coffee table legs would also be recommended to prevent rocking on uneven surface. The bottom edge could be profiled to allow a 50mm wide ‘foot’ at each corner:



There would be some likelihood of these narrow feet marking the bearing surface if larger loads are applied so it is recommended to add a rubber or felt strip below to soften the bottom edge.

### **Thermal Performance**

Thermal expansion and contraction are not expected to affect the structural performance of the coffee and tray tables.

### **Safety Factor**

Structurally it is recommended a safety factor of 1.5 be adopted for maximum loading on the furniture elements to account for manufacturing and installation tolerances and improper usage.

Overturning loads are based on geometry only and less reliant on connections and variance in material properties, so a lower safety factor of 1.1 has been applied to these results.

## Results Summary

Furniture Item	Failure load (kg)	Maximum safe working load SF=1.5 (vertical failure loads) SF=1.1 (overturning) (kg)
Square Coffee Table	>200kg Point Load between legs 230kg Edge Point Load (overturning)	130kg Point Load between legs 130kg Edge Point Load
Circular Coffee Table	>200kg Point Load between legs 70kg Edge Point Load (overturning)	130kg Point Load between legs 64kg Edge Point Load
Tray Table 400	>200kg Point Load between legs 4kg Edge Point Load (overturning)	130kg Point Load between legs 4kg Edge Point Load
Tray Table 500	>200kg Point Load between legs 6kg Edge Point Load (overturning)	130kg Point Load between legs 6kg Edge Point Load

It is recommended a layer of rubberised tape or similar is applied to the top edge of the aluminium coffee table legs to shim the gap and minimise lateral rocking. A foot or glide should also be installed at the bottom corners of the table to prevent rocking on uneven surfaces.